Hydration of the Upper Troposphere by Tropical Cyclones

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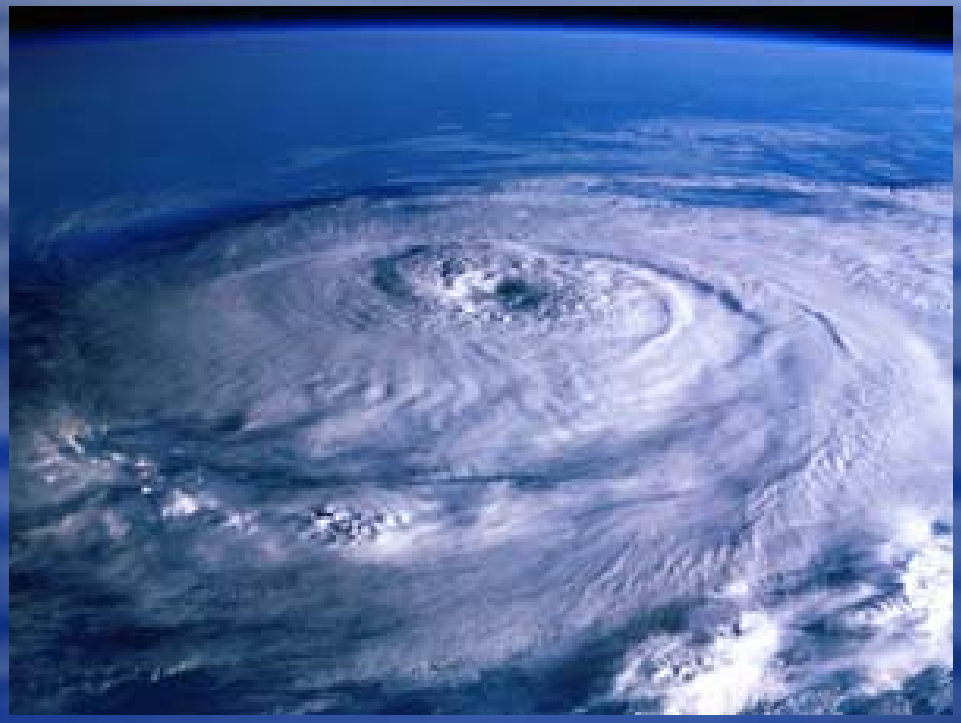
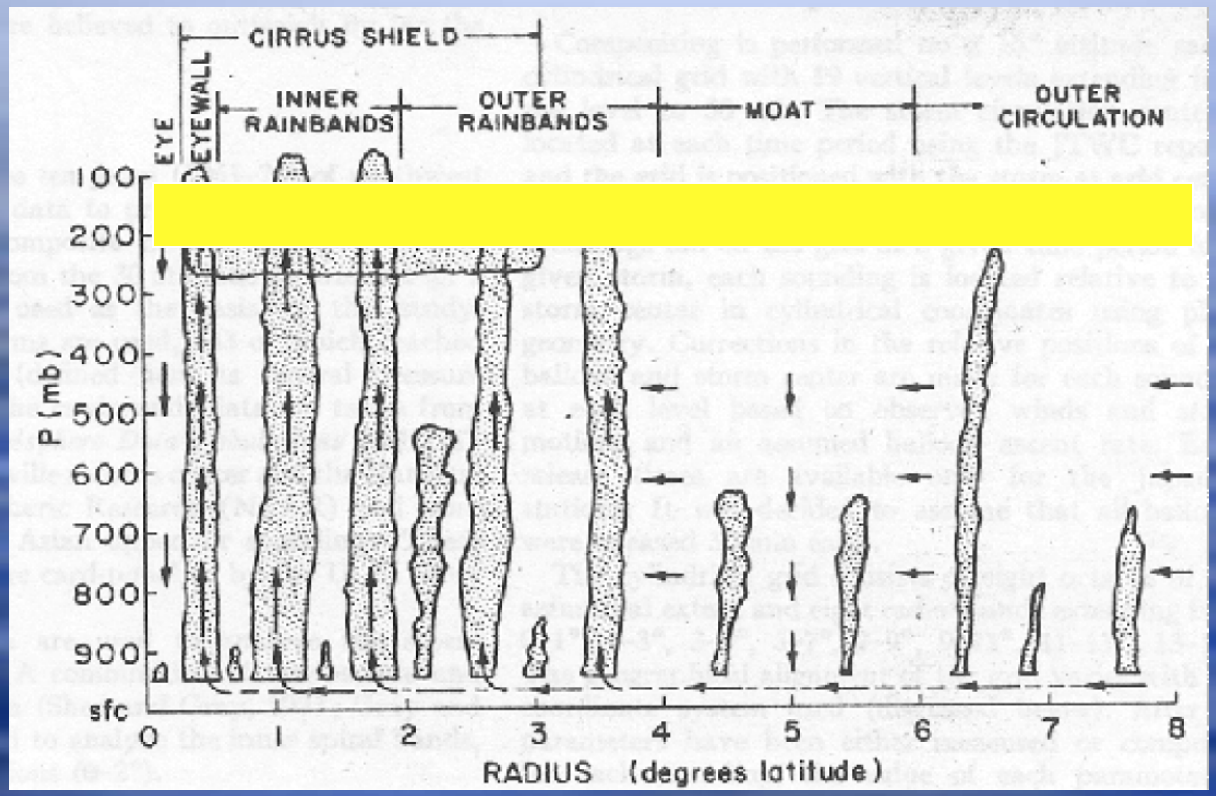
Introduction and Motivation

- Water vapor in the tropical and subtropical UT plays an important role in the radiative balance of the atmosphere.
- Tropical cyclones are potentially significant sources of water vapor to the UT.
- New satellite observations from AIRS and MLS are providing a unique view of the UT in the vicinity of tropical cyclones.

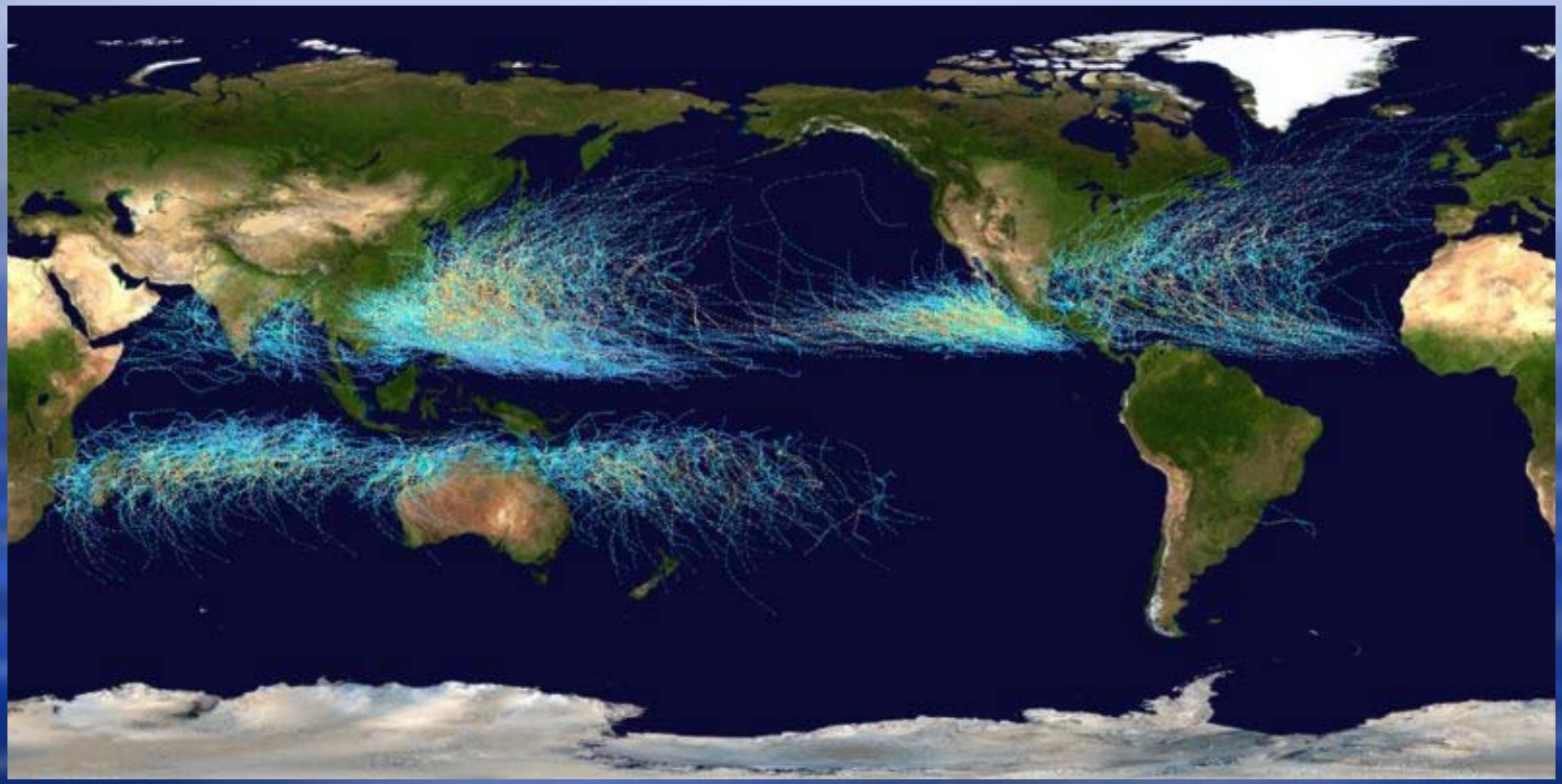


Schematic of Tropical Cyclone Vertical Cross Section



Frank, 1977

Tracks of Tropical Cyclones From 1985-2005



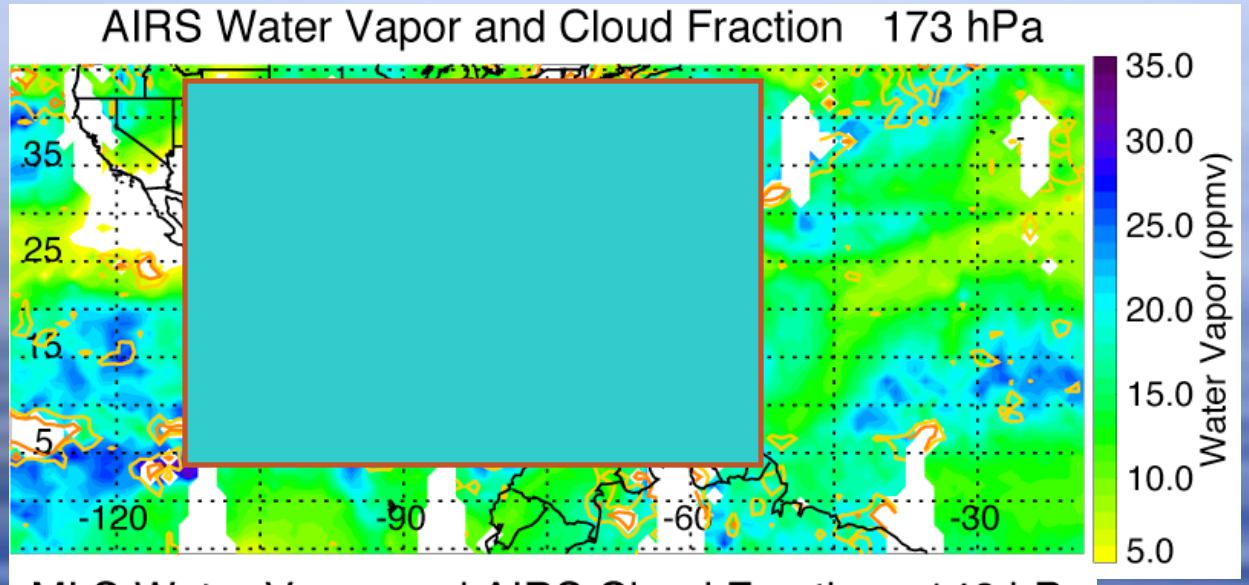
Number of cyclones used in this study (Aug. 2004 to Aug. 2006)

Western Pacific: 20 intense, 31 less intense

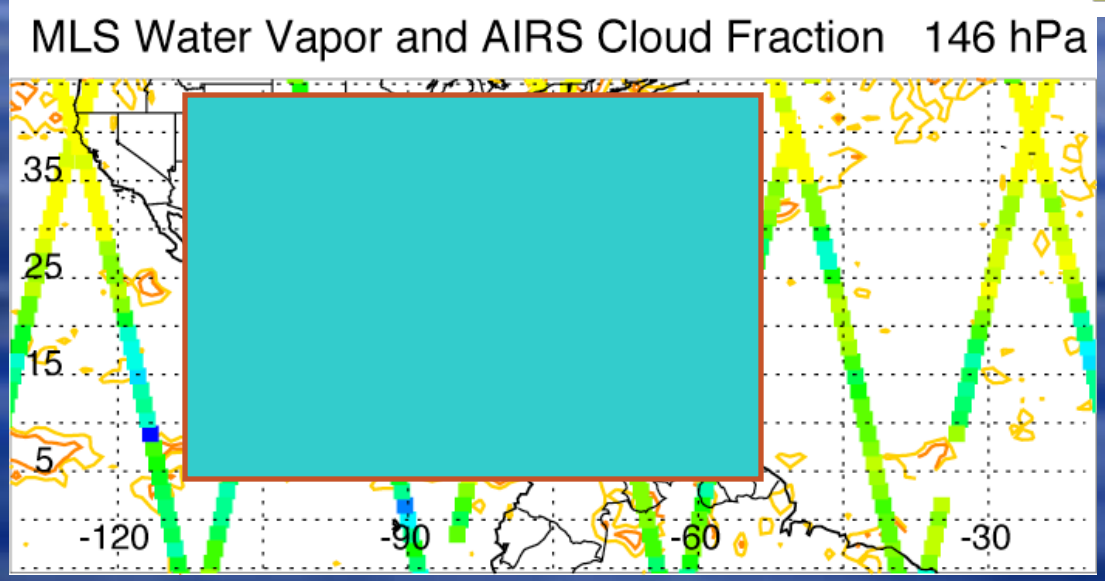
Atlantic: 9 intense, 36 less intense

Hurricane Dennis July 9, 2005

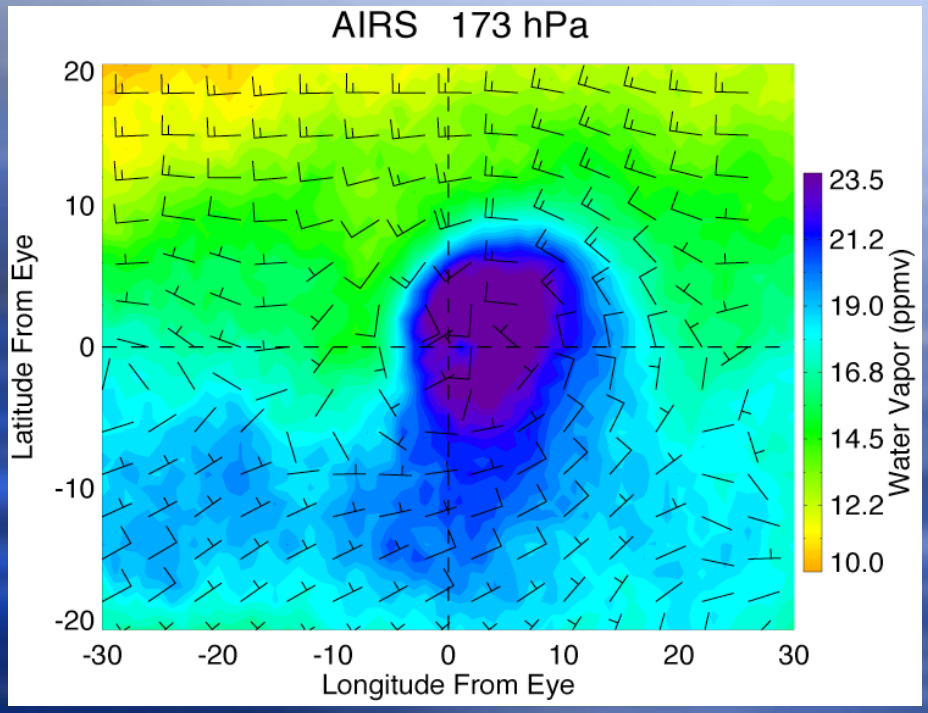
AIRS
Level 3

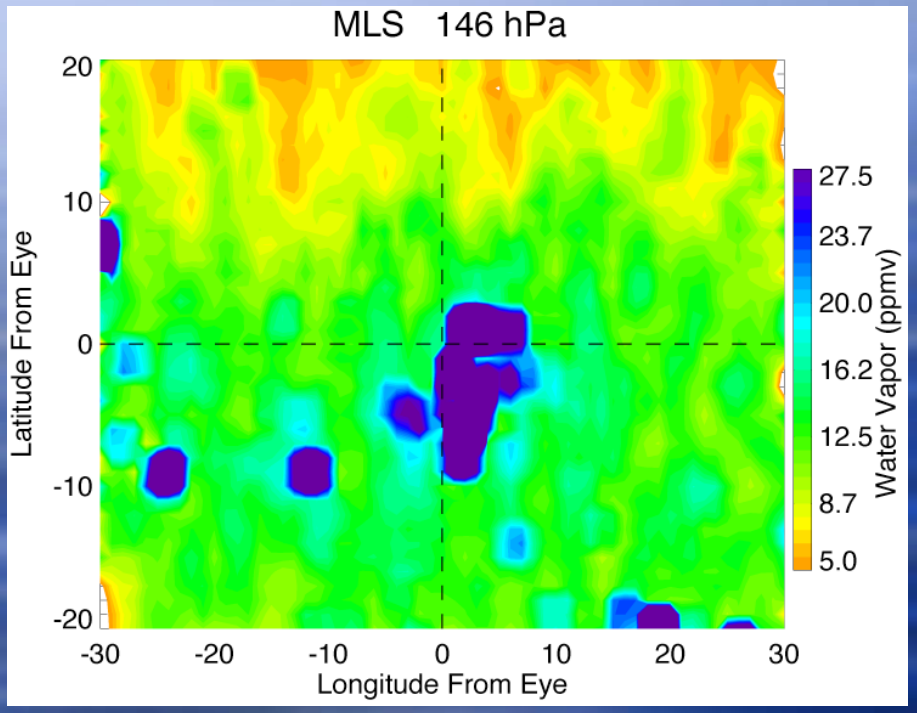


MLS
Level 2

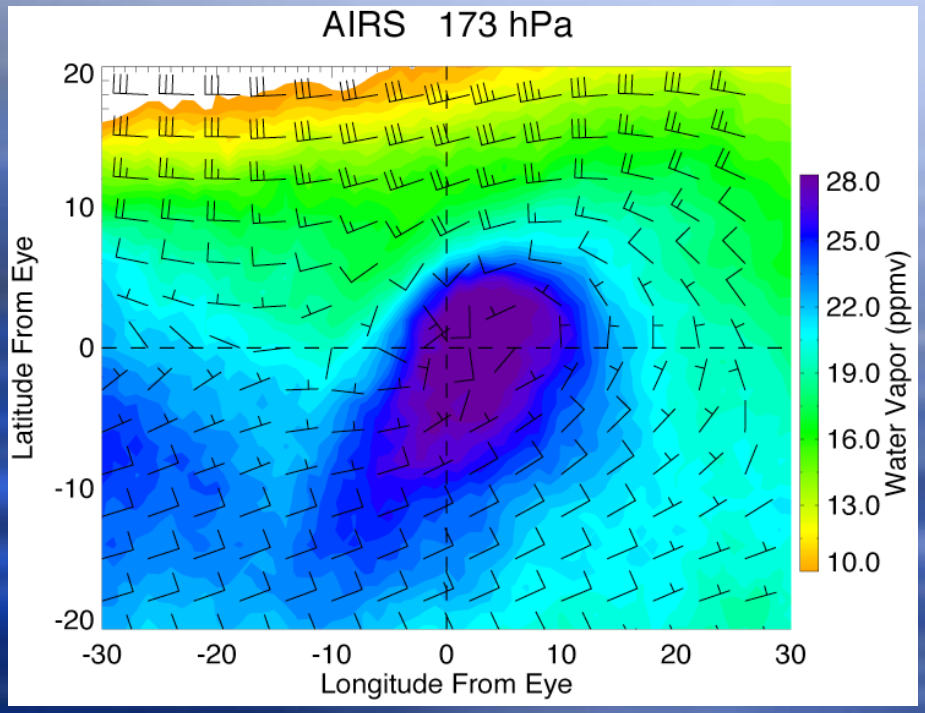


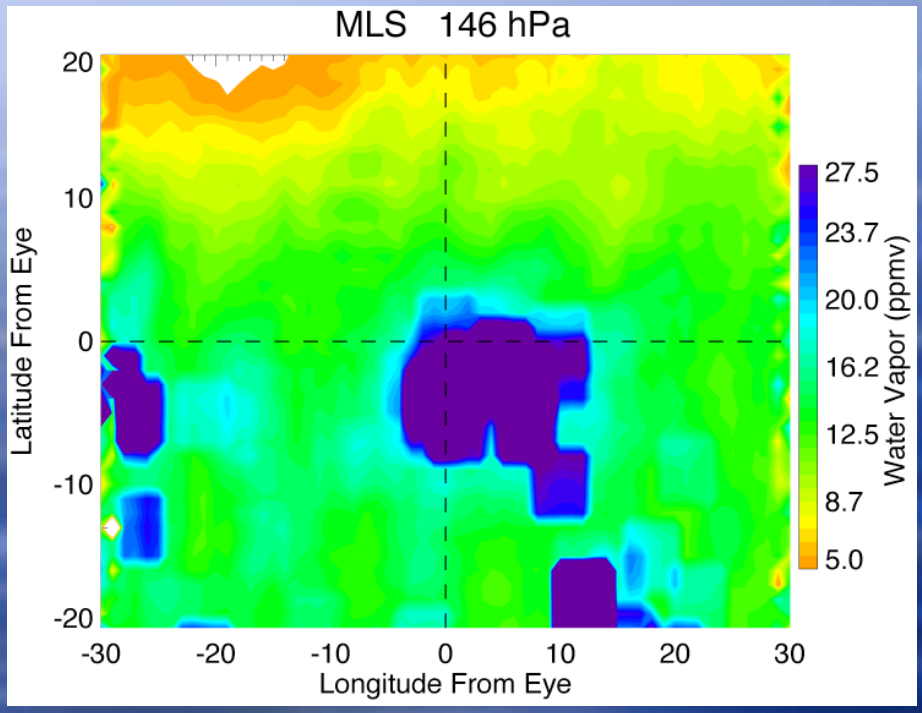
Atlantic Hurricane-Centered Water Vapor Averages 2004-6



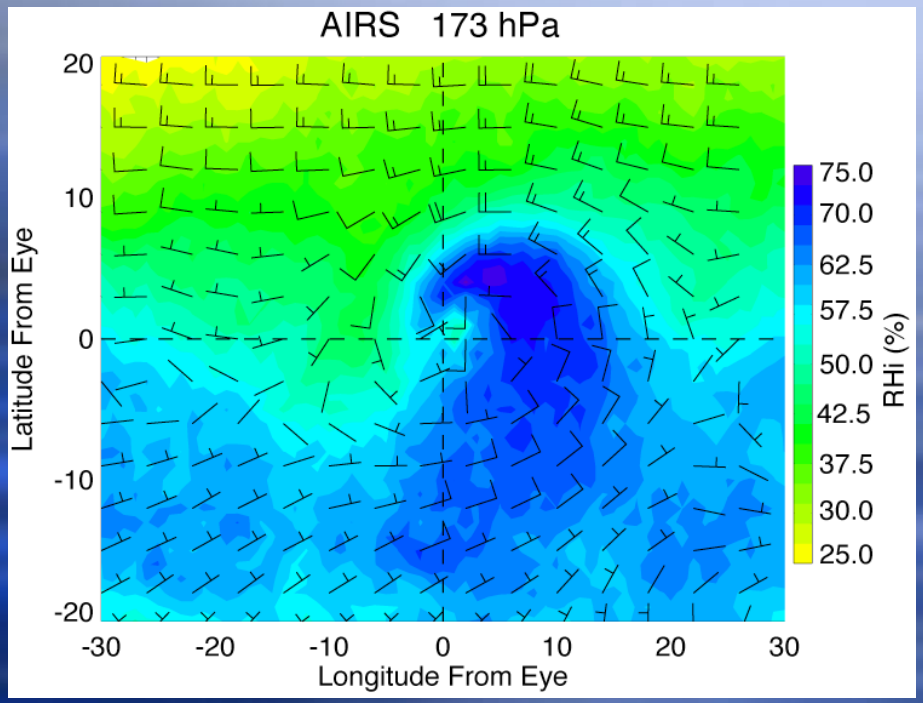


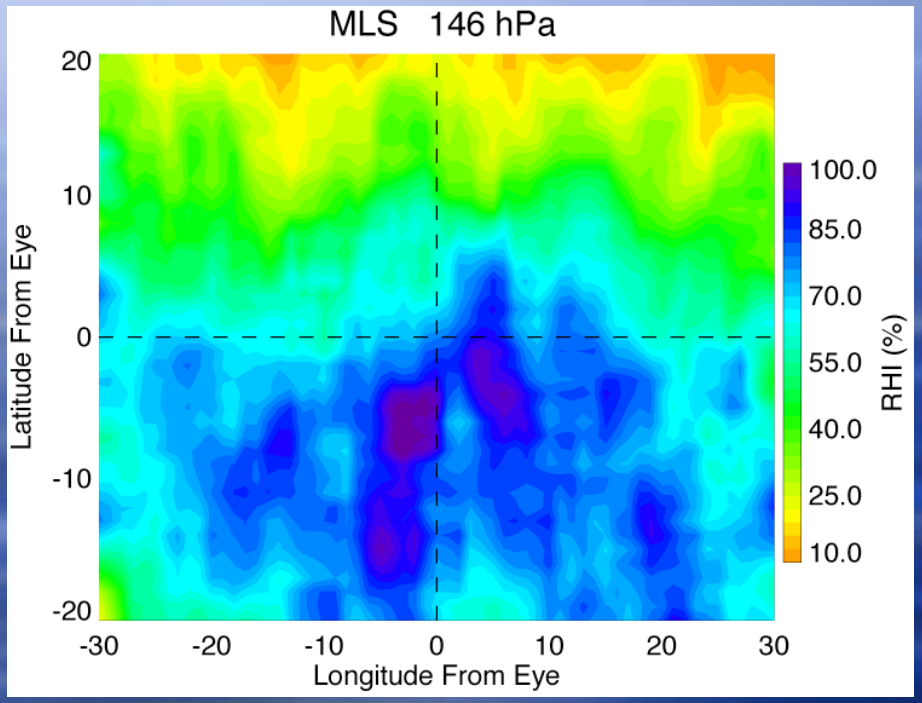
Western Pacific Typhoon-Centered Water Vapor Averages 2004-6



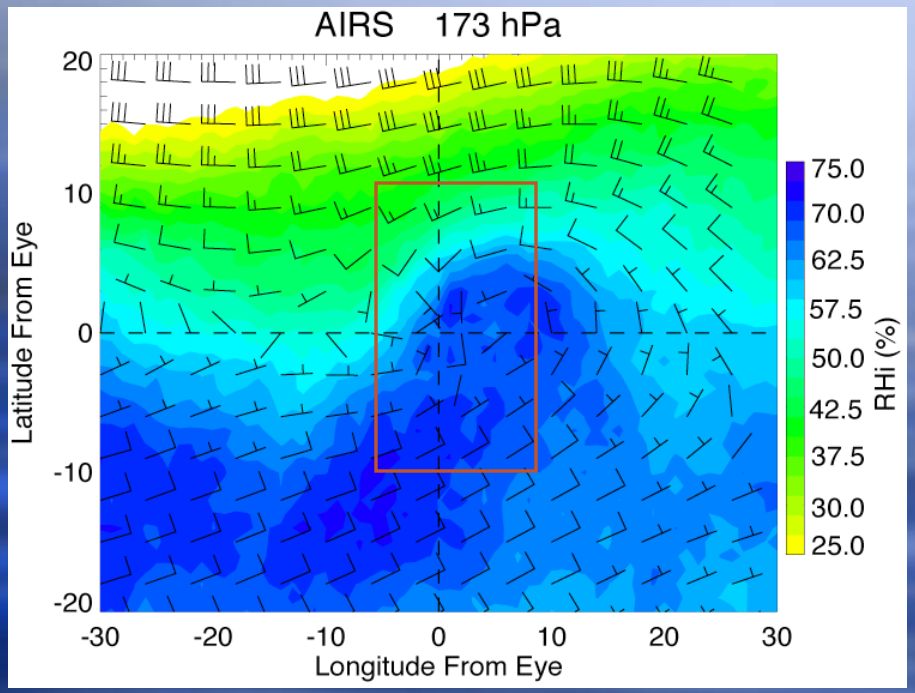


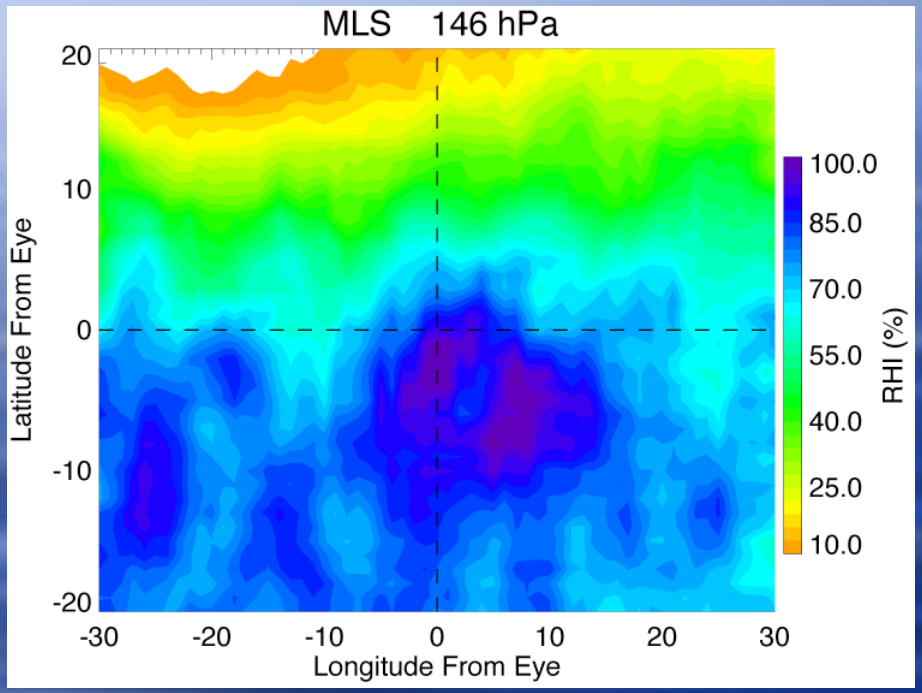
Atlantic Hurricane-Centered Relative Humidity wrt Ice



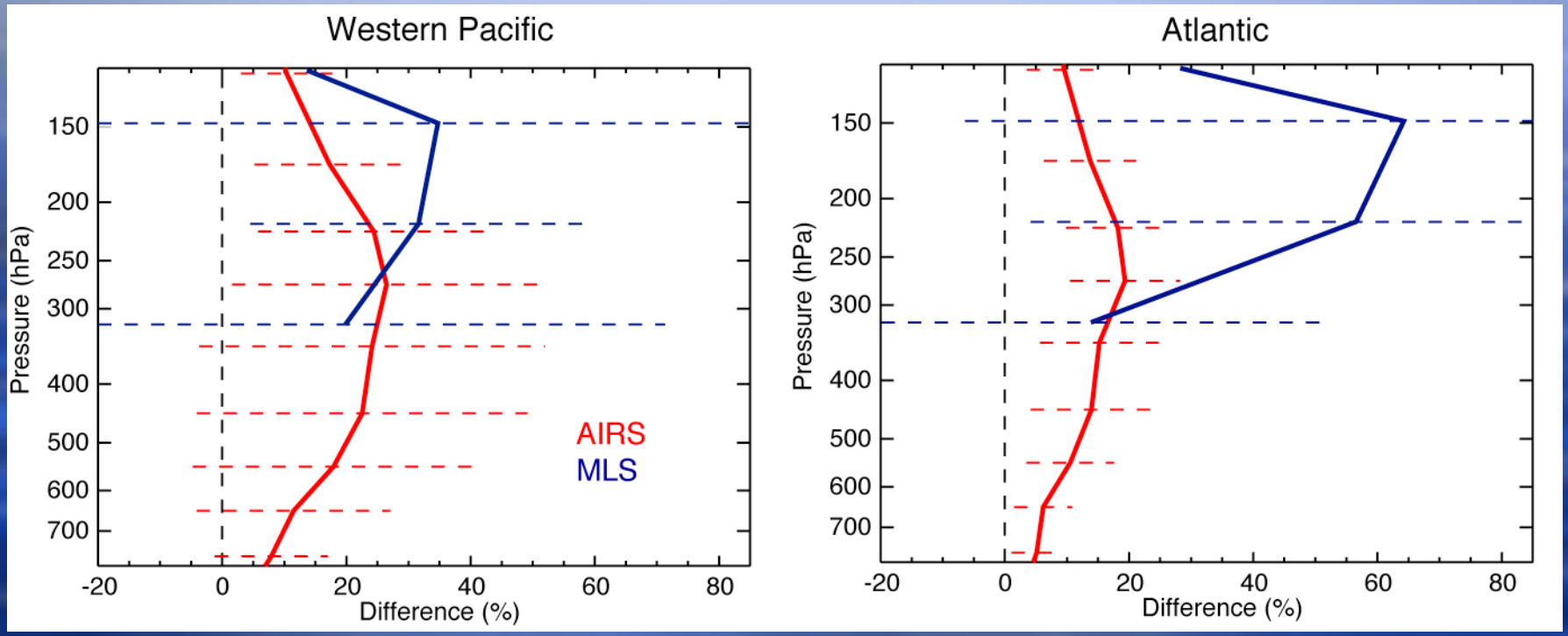


Western Pacific Typhoon-Centered RHi Averages

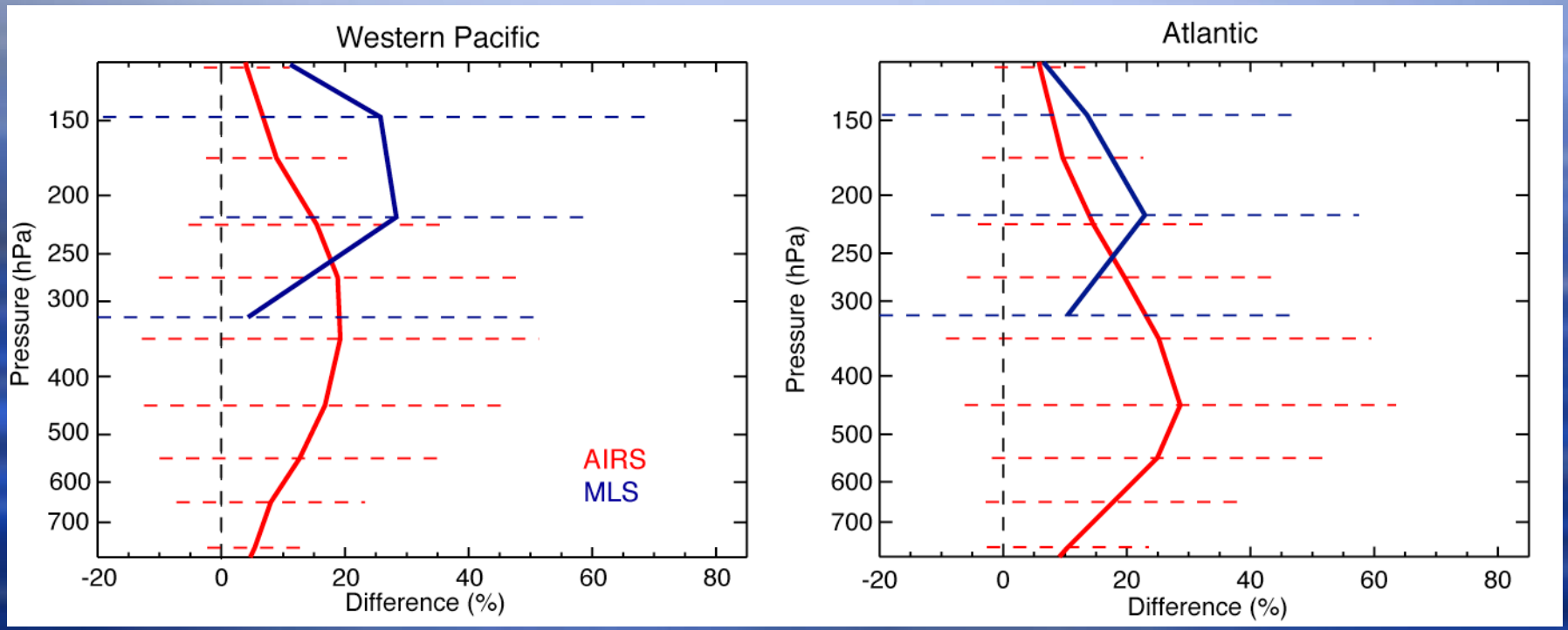




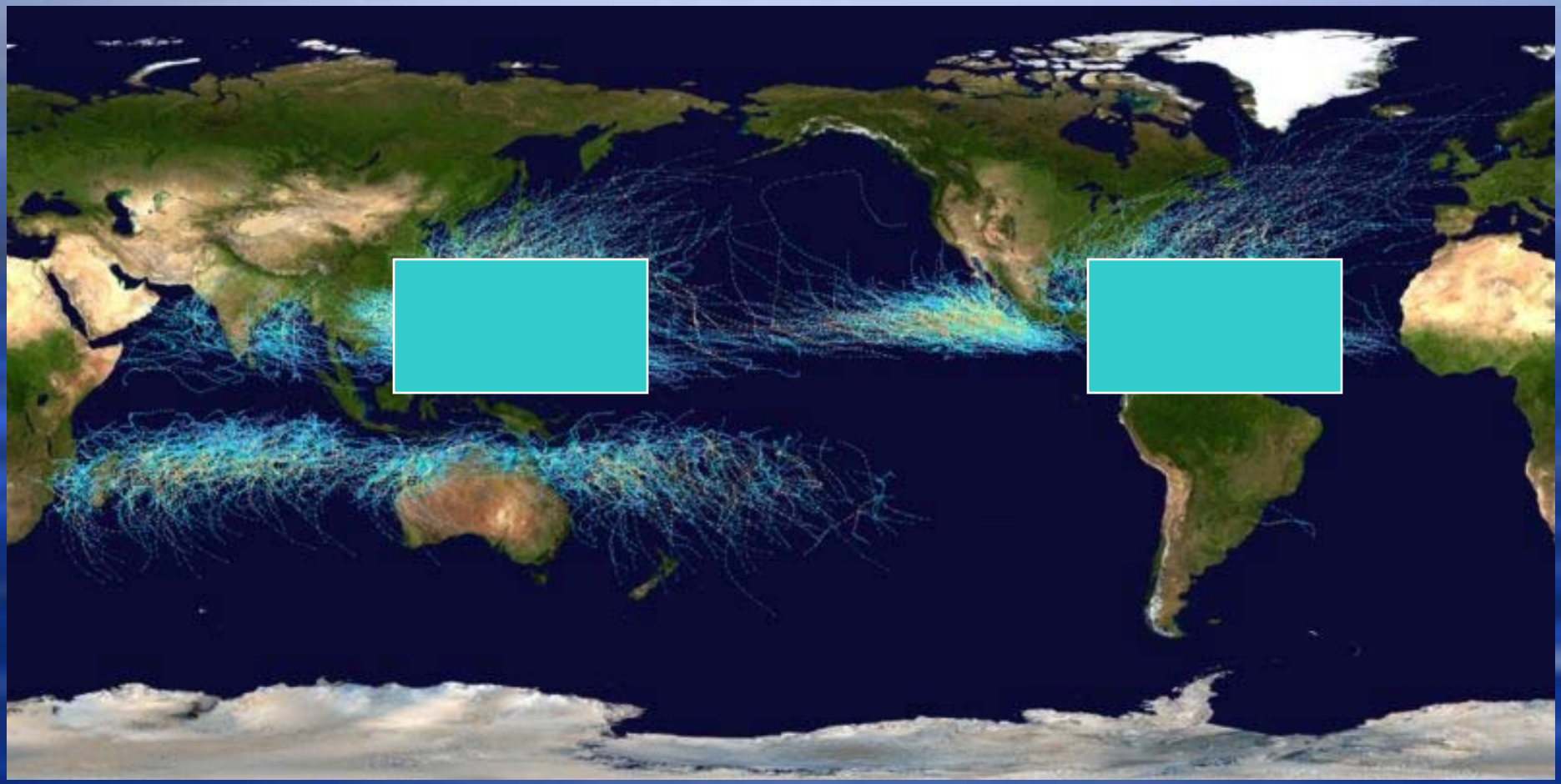
Average Water Vapor Differences From Monthly Means
Cat. 4-5 Cyclones



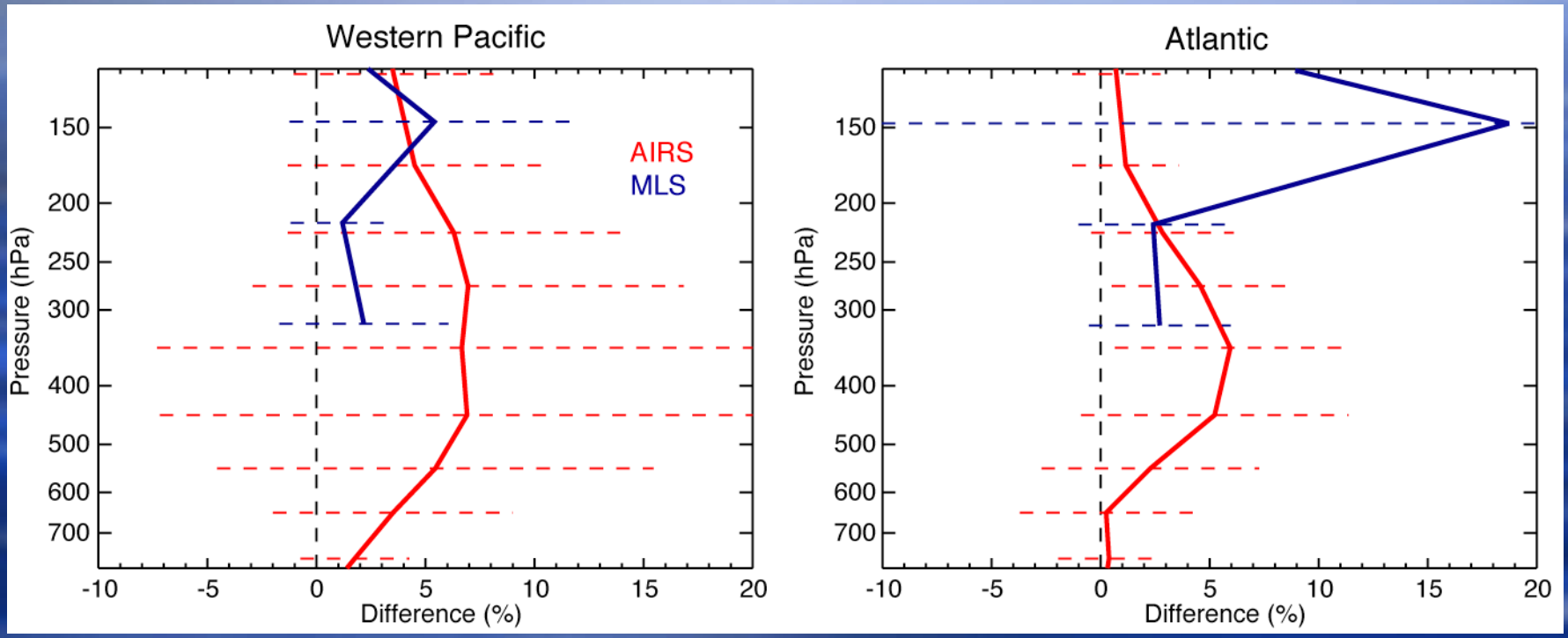
Average Water Vapor Differences From Monthly Means
TS-Cat. 3 Cyclones



Ocean Basin Averaging Regions



Water Vapor Differences From Monthly Means Averaged Over Ocean Basin Cat. 4-5 Cyclones

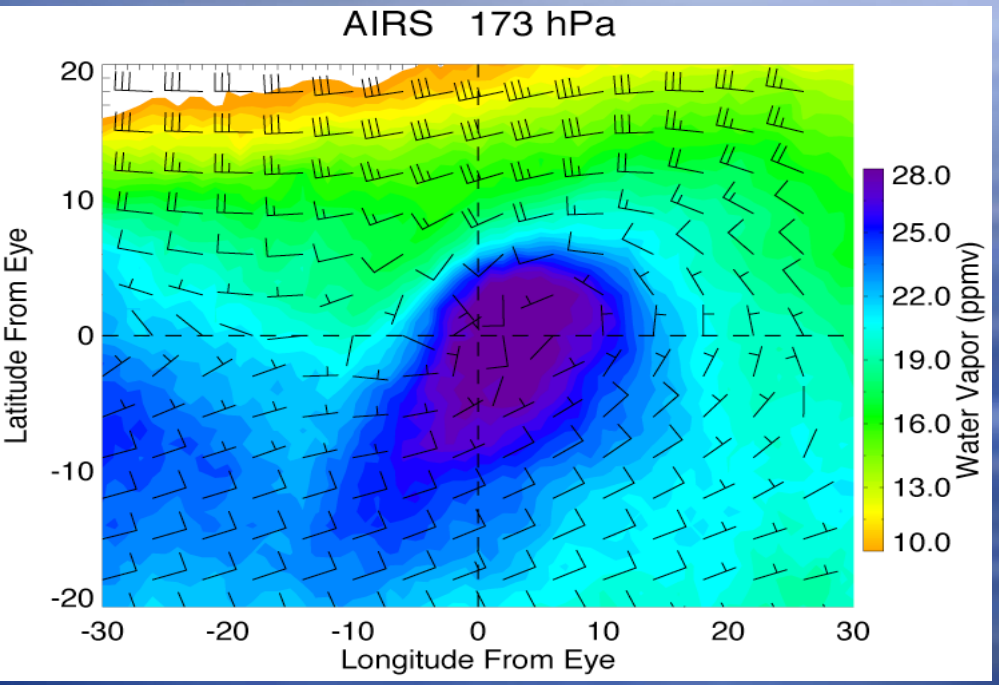


Conclusions

- Tropical cyclones hydrate the UT by 10-50% above monthly mean values in a 1500 km^2 area around the eye.
- Intense tropical cyclones are most effective at hydrating the UT but nearly all cyclones do to some extent.
- Average UT water vapor increases by up to 5-10% in the entire ocean basin in which the tropical cyclones occur.
- The impact of tropical cyclones on the global UT water vapor budget is still uncertain.

Average Water Vapor Comparison

Tropical Cyclones



Asian Monsoon